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CHAPTER 10.0 EFFECTS OF NURSE STAFFING ON SELECTED QUALITY MEASURES FOR LONG TERM RESIDENTS DERIVED FROM MDS[1]

10.1 Introduction

The aim of this Congressionally mandated study is to answer the empirical question:
Is there some ratio of nurses to residents below which long-term nursing home residents are at substantially increased risk of inferior care? The policy issue of whether minimum staffing standards should be required in nursing homes and if so, at what level, motivates this question. We are testing the hypothesis that identifiable thresholds exist below which quality of care is compromised. We do not need to demonstrate a linear relationship between staffing and quality of care, which clearly may not exist. However, depending upon the nature of the relationship between staffing and quality, we may find multiple thresholds associated with incremental increases in quality rather than a single inflection point above which there is no added benefit of additional staffing. Staffing ratios for RNs, LPNs, and nurse's aides may be associated with different quality measures because they provide different services.

The Minimum Data Set (MDS), the resident assessment instrument mandated by OBRA '87, the Nursing Home Reform Act, may be a useful tool for evaluating quality of care and life in nursing homes. Many of the MDS domains have been used as markers of quality in previous studies (Ouslander, 1997; Phillips et al., 1997; Hawes et al., 1997). Ramsay, Sainfort, and Zimmerman (1995) outlined 37 quality indicators from the MDS in 12 care domains. In these analyses, we used three quality measures, two of which represented quality of care domains and one representing quality of life. These are: improvement in ability to perform activities of daily living, pressure ulcer incidence, and improvement in resisting assistance with activities of daily living.

The most important and best supported of these quality measures is change in the ability to perform basic activities of daily living (ADLs): eating, transferring from bed to chair, bathing, walking, dressing and grooming, and toileting. Nursing home residents have multiple deficits in their ability to perform their ADLs; they rely on aides and nurses to perform or assist them with these activities. Two studies support the relationship between staffing and functional improvement. Spector and Takada (1991) reviewed the care of 2500 residents in 80 Rhode Island nursing homes. Those who lived in homes characterized by low staff-to-patient ratios and a high proportion of very functionally impaired residents

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were less likely to improve over a six-month time period. Residents in facilities with low RN turnover were more likely to improve. Cohen and Spector (1996) used the Institutional Population Component (IPC) of the National Medical Expenditure Survey (NMES) to examine quality, staffing and Medicaid reimbursement systems in a national sample of 2663 residents in 658 nursing homes. They found that a higher intensity of LPN staffing improved case-mix-adjusted functional outcomes.

Pressure ulcers are prevalent in nursing homes: 11% of nursing home residents develop new pressure ulcers during their first six months (Allman, 1997). The sores cause significant pain in half of affected individuals and are associated with substantially increased morbidity and mortality (Smith, 1995). Prevention requires mobilizing patients to achieve pressure relief. This activity is labor-intensive; to be effective patients must be moved every two hours. This work is performed primarily by nurse aides who must be adequately supervised. However, Cohen and Spector (1996) found that the prevalence of pressure ulcers was not affected by staffing ratios, yet prevalence rates may reflect differences in rates upon admission. Pressure ulcer incidence has proven very difficult to impact (McKenna, Moyers, & Feuerberg, 1998). Pressure ulcers are such an important cause of morbidity and mortality, however, that we include them as a quality measure in spite of evidence that they have been refractory to multiple interventions.

According to Bowers (1996), both aides and residents define high quality of care as that which "promotes physical comfort, not making residents wait or rush, and treating each resident like an individual". If the personal relationship between aides and residents is important and affected by staffing ratios, the rate that residents resist assistance with ADLs might be sensitive to staffing. For example, Kayser-Jones and colleagues (1997; Kayser-Jones, & Schell, 1997) have described the effect of inadequate staffing on feeding patterns in several nursing homes. When higher staffing was available, they observed that residents were far more likely to eat their meals because of the ongoing attention and assistance staff were able to provide. Though this measure has not been previously used as a marker of quality, we believe that it reflects quality of life dimensions not covered by other outcome measures and is important to both staff and residents. We hypothesize that both aide and licensed staff levels will impact resistance to care.

Controlling for case mix is essential in elucidating the association between staffing and quality. Without adequate control for case mix, we might find that facilities that staff most heavily will score worse on the quality measures merely because their residents have the greatest care needs and are at greatest risk for poor outcomes. Thus, risk adjustment for each quality measure will be emphasized in these analyses.

10.2 Methods

10.2.1 Design

The study is designed to examine associations between nursing home staffing levels, measured at the

facility level, and quality measures that are aggregated from the patient level to the facility level. Thus, the unit of analysis is the facility, and quality measures represent facility rates.
Recognizing that staffing probably does not necessarily have a linear relationship with quality, the design included use of continuous staffing and quality measures, as well as measures categorized into deciles and thresholds where staffing relationships might be most apparent. For each quality measure, we tested several thresholds in an attempt to identify the staffing ratio (or ratios) for each staff type that was most strongly associated with quality differences. We modeled the relationship between low staffing levels and quality using thresholds at the lowest 10%, 20%, and 30% of facilities and also used a recursive partitioning approach to find the staffing splits that explained the most variance in quality. We used multivariate methods to adjust for resident characteristics, but did not adjust for facility characteristics that were themselves strongly associated with staffing (e.g., for profit/non-profit, hospital-based/freestanding) because such adjustment would merely weaken the association between staffing and quality by using a proxy for staffing in the model. We did adjust for other facility characteristics (e.g., occupancy rate, urban/rural location, chain ownership).

10.2.2 Sample

Samples were extracted from the MDS database for New York and Ohio. New York and Ohio were chosen for this analysis because they are large, populous states that have been collecting the Minimum Data Set for several years. The two most recent years for which MDS data files are available were chosen for the study -- 1996 and 1997. These were a combination of MDS+ and MDS 2.0 data. Because we required information for case-mix covariates that preceded the time period during which quality was evaluated and because we needed to follow sampled residents beyond the date they were enrolled in the sample for outcome assessments, our data actually spanned the period between July 1995 and June 1998. Analyses from 1996 were conducted separately from the analyses of 1997 data because these included largely the same facilities.

The long-stay resident sample included all residents in the MDS database with at least two assessments completed 90 days apart (the follow-up form could occur 90 days after the sampling period) during the one-year period. By definition, these were long-stay nursing home residents for whom outcomes could be computed over a 90-day interval. Each resident was included in this file only once during the one-year interval, even if he or she remained in the facility for the full year (consecutive 90-day intervals for the same patient would not be mutually exclusive). Only facilities with at least 20 individuals were included in this sample. This restriction reduced our 1997 sample size from 663 to 653 facilities in New York and from 1,015 to 918 facilities in Ohio. The number of facilities dropped to 519 in New York and 728 in Ohio when we matched the quality measure data with Medicaid Cost Report staffing data.

10.2.3 Measures and Data

10.2.3.1 Quality Measures and Covariates

The criteria used for selecting quality measures included the following:

1. The quality construct was likely to be affected by nurse staffing;
2. A sufficiently high incidence rate was found such that the measure was stable;
3. Identifiable risk factors were identified for which we could adjust;
4. We expected secondary data to be accurate based on available information.

We began by considering an array of measures and eliminated those that did not meet these criteria. Quality measures that were not clearly in the domain of nursing staff (e.g., psychotropic drug use/prescription) were dropped in order to focus the analyses in the areas where nurses might have the most influence. Measures reflecting prevalence of conditions in nursing homes (e.g., rates of indwelling catheters, bladder incontinence, low Body Mass Index, pressure ulcers, and restraints) were not included because the mere presence of these conditions cannot be linked to quality of care in the nursing home; rather, they may reflect admission of a more complex case mix. However, incidence of these events (e.g., new pressure ulcers, new indwelling catheters, new restraints) were all considered as possible quality measures. While incident pressure ulcers had a high enough rate to be stable (Criterion 2), incident restraints, indwelling catheters, and many other conditions did not. While decline in function is potentially a more salient outcome for long-stay nursing home residents, we could not identify risk factors that predicted whether individuals decline in function in order to control for case mix, whereas we could identify characteristics relating to whether individuals improved in function (Criterion 3). We did not include variables with potential unreliability (e.g., toileting plan); accuracy problems for this item have been reinforced by other ongoing work (Criterion 4).

The long-stay quality measures were derived from the MDS data. They represented changes in health or behavioral status occurring over a 90-day interval where literature or clear hypotheses support relationships to staffing. At the resident level, these were dichotomous variables denoting either improvement or decline. Improvement was denoted when health or behavioral status was better at the second time-point compared to baseline, whereas staying the same or declining represented no improvement. Decline was denoted when health or behavioral status was worse at the second time-point compared to baseline, while staying the same or improving represented no decline.

The resident-level measures were then aggregated to the facility level. The denominator for these measures was the number of individuals in the facility for whom we had two MDS forms at 90-day intervals. However, exclusions were necessary for specific quality indicators that were impossible for certain individuals. For example, a resident who was at the best possible status could not improve, and thus was excluded from that improvement quality measure. Similarly, a resident who was at the worst level could not decline and so was excluded from that decline measure. These selectively reduced the denominator for individual measures. The numerator was the number of residents who improved or declined.

The case mix covariates for these quality measures were derived from the baseline MDS data (at the

first time point). They represent the prevalence rate of each condition in the facility sample.

Change in ability to perform basic ADLs is an important measure of nursing home quality. Though decline in ability to perform basic ADLs has not been shown to be related to nurse staffing, improvement in ability to perform basic activities of living has been repeatedly shown to be related to skilled (or licensed) nurse staffing (Spector & Takada, 1991; Cohen & Spector, 1996). Various standard measures have been validated for assessing functional change. Of these, we chose the Barthel Index (Wade & Collin, 1988; Mahoney & Barthel, 1965) because it has breadth, has been validated and used widely, and correlates with the ability to live independently in the community. We converted the relevant portions of the MDS to a Barthel Index **(**Appendix F., Table 3). Because the MDS does not assess the ability to climb stairs, a 90-point version of the Barthel was used. This conversion has been validated against an independent assessment of function performed by a research nurse. We considered a change of ten or more points clinically meaningful. Covariates for this measure included the residents' disabilities that make communication more difficult, thereby limiting potential functional improvement, including: hearing and visual impairment and moderately severe dementia as defined by a Cognitive Performance Scale score of four or more. The Cognitive Performance Scale is a validated measure of cognitive function based on the MDS (Morris et al., 1994; Hartmaier et al., 1995).

Pressure ulcers are wounds caused by excessive and prolonged pressure on skin. They are such an important cause of morbidity and mortality that we included pressure ulcer incidence as a quality measure in spite of evidence that prevalence has been refractory to multiple interventions. Pressure ulcers are graded by the depth of the wound. Stage 1 ulcers are persistent redness of the skin over a pressure point; stage 2 involves a break in the skin; stage 3 is defined by penetration of the wound below the skin; and stage 4 is damage to underlying muscle and/or bone. We defined incident pressure ulcer as a stage 2 or greater pressure ulcer which was not present on the baseline MDS. Being underweight, as measured by a body mass index (ratio of weight in kilograms to height in meters squared, "BMI") of less than 21 and being bedfast increase the risk of pressure ulcers, independent of the care that an individual receives. Thus, we controlled for BMI<21 and bedfast status in these models.

Change in resisting assistance with ADLs is a way to measure the personal relationship between residents and staff. According to Bowers and Kayser-Jones (1996 and 1999), patients and nursing staff regard the relationship that develops between a vulnerable adult and her caregiver to be of paramount importance in determining the quality of a resident's life. Residents describe the importance of gentleness, personal engagement, not being rushed and feeling respected. Aides report that they value having time to promote physical comfort, not make residents wait or rush, and share treats or personal stories. We reasoned that over time residents who initially resist assistance with ADLs out of fear or confusion should gradually become more accepting of care if well-trained and supervised staff are available to permit development of personal rapport. Improvement is defined as not resisting assistance with ADLs at the second assessment if resistance had been noted at the first. Covariates for

this measure included hearing, visual and cognitive impairment as defined above, as well as moderate to severe functional impairment, as denoted by a Barthel score of 25-70. Below a score of 25, residents are totally dependent in ADLs and may be incapable of resistance; above a score of 70, patients may need little or no assistance with ADLs.

10.2.3.2 Staffing Measures

We used four different staffing measures for these analyses: nurse's aide staff hours per resident day, LPN hours per resident day, RN hours per resident day, and the sum of RN and LPN hours per resident day. Types of staff were separated for these measures because from both a policy and clinical perspective, we need to be able to isolate the effects of different types of staff on quality. However, for many functions, there is widespread substitution between RN and LPN staff in nursing homes due to unavailability of RNs and to the numerous years of experience that some LPNs have in nursing home care. This is not to say that their qualifications are equivalent, only that they may function in similar roles in different nursing homes depending upon staff availability. Even if relationships between LPN staffing and quality or RN staffing and quality are not strong, it is possible that the sum of these two types of staff can be significantly associated with quality.

Staffing measure development, testing and editing procedures are described elsewhere (Chapter 8). We chose the most reliable staffing measure possible while preserving sample size to the greatest extent. Staffing data from the Medicaid cost report was used rather than OSCAR data, because it was found to be more valid in a comparison with payroll data. The correlation between Medicaid cost report data and payroll data was 0.73 for RN staffing, 0.64 for LPN staffing, and 0.39 for nurse's aide staffing. However, Medicaid cost report data were available only for facilities that were Medicaid-certified and restricted the final sample to those that could be matched to the MDS data sample. We eliminated extreme outliers (total hours per resident day < 0.5 or > 12) which comprised only 1% of the samples of facilities with Medicaid staffing data. We chose not to exclude facilities on any other basis, such as consistency of staffing information over time, because such changes can represent actual staffing changes in a facility that occur because of changes in ownership, administration, case mix, and staff availability.

10.2.3.3 Facility Characteristics

The risk of masking an association between staffing and quality is substantial if facility characteristics are co-linear with staffing. Thus, facility characteristics were selected based on hypothesized associations with quality, and only after examining correlations between facility covariates and staffing measures. Those factors strongly associated with staffing were problematic to include. The three facility covariates that we included were: urban/rural location, multi-facility organization, and occupancy rates. We did not include ownership or hospital-based/freestanding because these characteristics were highly correlated with staffing levels. For example, the correlation between for-profit and nurse's aide hours

was -0.26 ($p < .001$). The correlation between hospital-based and RN hours was 0.25 ($p < .001$). In some states, these correlations were even higher. We considered the use of one additional variable relating to physician FTEs for medical directors, but found such a large portion of missing data and responses of "0 FTE" that we could not use this variable.

Functional improvement may be much more related to staffing levels of physical and occupational therapists than nursing, so we needed to determine whether therapist time substituted for nursing time, effectively reducing the nurse staffing level while maintaining or even improving quality. Thus for this measure we adjusted for therapy staffing levels that include both staff and contract therapy hours per resident day.

10.2.4 Analysis

10.2.4.1 Descriptive Analyses

We determined the mean, median, range, and interquartile range for all of the study variables including quality measures, covariates, and staffing measures by year and by state. We conducted similar analyses on the pooled data across states for each year. We examined correlations among the variables including staffing levels and quality measures, covariates and quality measures, facility variables and staffing levels, and facility variables and quality measures.

A second type of descriptive analysis involved classifying facilities into staffing deciles and displaying quality of care and case mix deciles for the different staffing deciles. We chose deciles as a starting unit to assure that we had a sufficient sample size in each category for quality of care comparisons. The purpose of this descriptive analysis was to identify whether specific staffing thresholds were apparent below which quality measure values were lower in comparison to those above the threshold. However, the limitation of this descriptive analysis was that without risk adjustment, higher rates on the hospital transfer quality indicators could as easily reflect case mix as staffing.

A third type of descriptive analysis that we conducted involved using PC-Group (1992), a recursive partitioning program. PC-Group divides the sample into a specified number of groups such that facilities within each group are as similar as possible on a given measure and facilities in different groups are as different as possible on the measure. The algorithm identified the optimal level of staffing to divide the facilities into groups with better or worse quality. The limitation of this descriptive approach was that without risk adjustment, differences in quality measures could reflect case mix rather than staffing levels that were used to define the splits. The advantage of this approach is that it was not restricted to deciles or other relative categories and more than one threshold was possible. In some cases, PC-Group could not identify any splits that explained differences in quality.

10.2.4.2 Risk Adjusted Analyses

We used ordinary least squares regression to examine linear associations between staffing levels and quality measures, and between staffing deciles and quality measure deciles, after adjusting for the case mix covariates. We also used logistic regression to estimate the likelihood of a facility being in the lowest decile and the lowest two deciles, if staffing was below the lowest staffing decile or two deciles. Third, we used the splits derived from PC-Group to estimate the likelihood that a facility was in the lowest decile in terms of quality if staffing were below the PC-Group staffing threshold after adjusting for case mix. Fourth, we used the best logistic regression models and adjusted for facility characteristics that were not highly associated with staffing including occupancy rate, chain, and urban/rural provider. These analyses were conducted separately for each state and each year. The results reported include the staffing levels that are most strongly associated with quality based on our analyses.

10.3 Results

The mean facility percent and standard deviation for the long-stay resident staffing measures, quality measures and covariates are provided in Table 10.1 for New York and Ohio. Quartile ranges and the medians are shown in Appendix F., Table 4. The mean for the functional improvement measure, for example, represents the average percentage of patients per site who improved in function. The distributional characteristics of the quality measures reflect skewed distributions in which facilities in the upper quartile exhibit substantially higher rates than the median or mean.

The facility rates varied between states. Staffing levels were generally higher in Ohio than New York. Quality was better in Ohio for pressure ulcers and better in New York for functional improvement and resisting care improvement. Resident level covariates were similar between the two states, except the prevalence of bedfast residents was higher in New York facilities. Ohio facilities were more frequently rural, part of a large corporation and proprietary, but had lower occupancy rates than facilities in New York.

Table 10.1 Descriptive statistics for staffing, quality, case mix, and facility measures

Measures	Ohio 1996 (n=682)		Ohio 1997 (n=727)		New York 1996 (n=517)		New York 1997 (n=506)	
	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)
Staffing (in hours per resident day)								
Aide	2.19	(0.48)	2.16	(0.49)	2.01	(0.36)	2.04	(0.36)
LPN	0.77	(0.27)	0.78	(0.29)	0.59	(0.22)	0.61	(0.22)
RN	0.51	(0.28)	0.54	(0.31)	0.32	(0.18)	0.32	(0.18)
RN+LPN	1.28	(0.41)	1.32	(0.43)	0.90	(0.24)	0.92	(0.24)
Quality Measures (% of residents with each outcome)								
Incident pressure ulcers (Stage 2-4)	3.92	(2.82)	3.82	(2.81)	5.05	(2.52)	4.90	(2.79)
Functional improvement	8.18	(4.98)	8.14	(5.01)	14.71	(12.71)	11.56	(11.31)
Resisting care improvement	26.09	(24.06)	25.78	(22.71)	33.83	(29.61)	29.29	(25.41)
Covariates (% of residents with each condition at baseline)								
Hearing impairment	2.45	(4.46)	2.31	(4.20)	2.10	(2.11)	2.08	(2.28)
Visual impairment	17.72	(10.70)	17.77	(10.65)	17.95	(9.57)	18.18	(9.82)
Peripheral vision impairment	5.39	(6.39)	5.98	(8.61)	3.56	(4.76)	3.58	(4.88)
Cognitive performance scale $4	9.00	(6.75)	9.60	(6.89)	10.56	(5.68)	10.84	(5.85)
BMI<21	30.41	(7.55)	29.41	(7.93)	33.15	(7.72)	31.89	(7.77)
Bedfast	7.38	(6.20)	6.99	(5.86)	3.42	(3.92)	3.21	(4.07)
Barthel score between 25-70	49.75	(9.06)	49.84	(9.10)	45.21	(10.29)	45.24	(9.99)
Therapy hours per day	0.16	(0.24)	0.17	(0.20)	0.09	(0.11)	0.10	(0.10)
Facility Characteristics (% of facilities)								
Urban	74.93	---	74.21	---	87.81	---	87.15	---
Chain	53.96	---	53.37	---	12.77	---	13.04	---
Proprietary	78.15	---	76.75	---	50.87	---	51.38	---

Occupancy rate	85.44	(17.02)	83.99	(17.88)	96.27	(7.62)	96.24	(6.37)

Within each state, quality measures were consistent over time, and associations found in one year were reflected in the other year. For these analyses we report associations between staffing and quality for 1996 only, while in Chapter 12 we present some of the 1997 findings. The likelihood that a facility was in the worst decile was estimated for several different staffing thresholds, using logistic regression to control for relevant case mix covariates. As presented in Table 10.2, the likelihood or odds of a facility being in the worst 10% of facilities on pressure ulcer incidence were 4.97 times greater with LPN staffing less than .77 hours per resident day and 2.49 times greater with RN staffing less than .109 hours per resident day. Seventy-eight percent (78%) and 9% of facilities, respectively, fall below these thresholds. The relationship between nurse's aide staffing and incident pressure ulcers is less pronounced in New York, but strong in Ohio. As illustrated in Tables 10.3 and 10.4, these associations were found after controlling for the proportion of a facility's residents who have low body weight or are bedfast. Relationships between staffing and pressure ulcer incidence were similar in 1997.

In Ohio, but not in New York, facilities in the lowest RN staffing decile were 2.58 times as likely to be in the worst decile of facilities for functional improvement. This model controlled for hearing, visual and cognitive impairment, and therapy hours/resident/day. Though the relationship between functional improvement and staffing did not hold at the LPN level, when licensed staff were considered together (RN plus LPN), facilities in the lowest 20% of staffing were 2.62 times as likely to have low rates of functional improvement (Table 10.5). Relationships between staffing and functional improvement were also found in 1997.

In Ohio, low LPN, RN, and total licensed (RN plus LPN) staffing levels were associated with lower rates of resisting care improvement. This model controlled for hearing, visual and cognitive impairment, as well as percent of residents in the facility with moderate to severe functional impairment (Table 10.6). Relationships between staffing and resisting care improvement were also found in 1997.

10.4 Discussion

We have demonstrated a relationship between lower staffing levels and greater likelihood of poor outcomes for nursing home residents who remain in nursing homes 90 days or longer. Thus we affirm our hypothesis that there are identifiable staffing levels below which quality of care may be compromised. As anticipated, we found different thresholds associated with incremental increases in quality and with different skill levels of staff.

Our MDS quality measures were carefully chosen to reflect incident events, clearly in the domain of nursing staff, supported by published studies on nursing home quality and staffing, and adjustable for risk. Function is particularly important to residents' quality of life. The ability to regain a modicum of independence affects the quality of a resident's life as well as, ultimately, the costs and amount of care they require. Functional improvement is a measure where there is excellent support from large previous

studies that staffing levels impact quality (Spector & Takada, 1991; Cohen & Spector, 1996). Like previous studies, we found that the relationship held true for licensed staff, and was not altered by levels of therapy staffing. We were able to show a relationship only in Ohio. The lowest staffing deciles in New York were significantly lower than in Ohio (0.47 vs 0.30 LPN/resident/day; 0.25 vs 0.11 RN/resident/day). In future qualitative analyses it will be important to examine why there was such variability between states. It would also be useful to look at other states where the MDS has been in use and the data have been shown to be carefully audited (e.g., Maine) to try to corroborate the findings in Ohio.

Table 10.2 Likelihood of quality measure occurrence below vs. above the specified staffing level in 1996

Quality Measure	Staff Type	Staffing Hours per Resident Day *	Adjusted Odds Ratio (95% CI)†	p- value	% of Facilities Below Staffing Hours ‡
New York					
Incident	Aide	Below 2.00	1.65 (0.92 - 2.97)	.095	42.7
Pressure Ulcers	LPN	Below 0.77	4.97 (1.51-16.38)	.008	78.0
	RN	Below 0.109	2.49 (1.06 - 5.89)	.037	9.1
	RN+LPN	Below 0.90	1.64 (0.91 - 2.96)	.101	49.3
Functional	Aide	Below 1.53	Not calculable	.965	9.7
Improvement	LPN	Below 0.30	0.83 (0.31 - 2.21)	.713	10.5
	RN	Below 0.11	1.05 (0.43 - 2.61)	.910	9.5
	RN+LPN	Below 0.60	0.33 (0.08 - 1.40)	.132	10.3
Resisting Care	Aide	Below 1.53	1.66 (0.77 - 3.54)	.194	9.7
Improvement	LPN	Below 0.31	1.50 (0.72 - 3.14)	.281	11.3
	RN	Below 0.21	0.66 (0.37 - 1.18)	.159	29.3
	RN+LPN	Below 0.81	1.14 (0.66 - 1.96)	.647	33.0
Ohio					
Incident	Aide	Below 1.08	7.78 (2.50-24.23)	<.001	1.6
Pressure Ulcers	LPN	Below 0.47	0.76 (0.31 - 1.83)	.534	9.0
	RN	Below 0.25	0.79 (0.33 - 1.91)	.599	8.7
	RN+LPN	Below 0.71	2.46 (0.77 - 7.82)	.127	2.2
Functional	Aide	Below 1.62	1.01 (0.39 - 2.65)	.984	8.8
Improvement	LPN	Below 0.47	0.99 (0.38 - 2.61)	.986	9.0
	RN	Below 0.25	2.58 (1.21 - 5.49)	.014	8.7
	RN+LPN	Below 1.01	2.62 (1.43 - 4.83)	.002	20.4
Resisting Care	Aide	Below 1.62	1.37 (0.69 - 2.70)	.365	8.8
Improvement	LPN	Below 0.47	1.88 (0.99 - 3.57)	.054	9.0
	RN	Below 0.21	3.08 (1.47 - 6.45)	.003	5.0
	RN+LPN	Below 0.8865	1.81 (0.97 - 3.38)	.061	9.6

* Staffing level representing the treatment variable ("1" denotes below and "0" denotes above) in the logistic regression model estimating the effect on quality.

† Odds that a facility with staffing hours per resident day below the cutoff will be in the worst quality decile relative to facilities with staffing hours per resident day above the cutoff, after adjusting for case mix variables.

‡ The percentage of nursing homes in New York with staffing hours per resident day below the tested cutoff

Table 10.3 Likelihood of being in the worst decile for incident pressure ulcers when LPN staffing is low (New York)

Variable	Adjusted Odds Ratio	95% CI for Odds Ratio	p-value
BMI < 21 decile	1.26	(1.12 - 1.41)	<.001
Bedfast decile	1.03	(0.93 - 1.14)	.615
LPN hours < 0.77 per resident day	4.97	(1.51-16.38)	.008

Table 10.4 Likelihood of being in the worst decile for incident pressure ulcers when Aide staffing is low (Ohio)

Variable	Adjusted Odds Ratio	95% CI for Odds Ratio	p-value
BMI < 21 decile	1.03	(0.94 - 1.12)	.536
Bedfast decile	1.11	(1.02 - 1.21)	.020
Aide hours < 1.08 per resident day	7.78	(2.50-24.23)	<.001

Table 10.5 Likelihood of being in the worst decile for functional improvement when RN+LPN staffing is low (Ohio)

Variable	Adjusted Odds Ratio	95% CI for Odds Ratio	p-value
Hearing impairment decile	1.05	(0.96 - 1.16)	.285
Vision impairment decile	0.99	(0.89 - 1.10)	.880
Peripheral vision impairment decile	0.90	(0.81 - 1.00)	.047
Cognitive performance scale $4 decile	1.05	(0.94 - 1.16)	.398
Therapy hours per resident day	0.38	(0.05 - 2.73)	.334
RN+LPN hours < 1.01 per resident day	2.62	(1.43 - 4.83)	.002

Table 10.6 Likelihood of being in the worst decile for resisting care improvement when RN staffing is low (Ohio)

Variable	Odds Ratio	95% CI for Odds Ratio	p-value
Hearing impairment decile	1.06	(0.99 - 1.14)	.121
Vision impairment decile	0.95	(0.88 - 1.03)	.194
Barthel score between 25-70 decile	1.00	(0.92 - 1.08)	.893
Cognitive performance scale $ 4 decile	0.88	(0.81 - 0.95)	.001
RN hours < 0.21 per resident day	3.08	(1.47 - 6.45)	.003

Pressure ulcer prevention is an important measure of quality in that it has quality of life, infection control and quality of care implications. It is highly visible to residents, families and regulators. This is the first large study to find a relationship between staffing and incident pressure ulcers, and we found it in both

states. Unlike Cohen & Spector, we had the advantage of looking at incident, rather than prevalent, pressure ulcers. Incidence more accurately reflects the result of care received in a facility.

Pressure ulcer prevention depends on labor-intensive measures like turning immobile patients every two hours to relieve pressure. While this is the domain of nurse aides, we found relationships between this measure and both skilled and unskilled staff. Clearly, preventing ulcers requires both an adequate ratio of nurse aides to patients, as well as enough licensed staff to supervise their efforts.

Our third quality measure, improvement in resisting care, has not been previously studied. It attempts to measure the important but difficult-to-capture quality of the interpersonal relationships between vulnerable residents and their caregivers. Both residents and staff regard the quality of their relationship to be a key determinant of the quality of nursing home life. An excerpt from Kayser-Jones (1997a) participant-observer studies on feeding patterns is illustrative.

> *Mrs. C., a 90-year-old woman with advanced Alzheimer's disease, had a moderate to severe oropharyngeal dysphagia... At lunchtime, Mrs. C. was often fed by a restorative nursing assistant (RNA), a staff member with special training in how to feed residents. He was very patient when feeding Mrs. C.; he fed her slowly and waited as long as a minute and a half in between spoonfuls. Because there were more staff members on duty during the day, this RNA usually fed only two or at most three residents. Typically he sat between two residents, first giving one a bite and, while giving that person time to swallow, offering a spoonful of food to the other resident.*
>
> *...Although this woman was nearly aphasic, the RNA maintained a playful social interaction with her throughout the meal. Sometimes when he offered her a spoonful of food, she looked at it and said, "No." In return he smiled and said, "Yes?" With a sly smile on her face, she said "Ahh," and opened her mouth to receive the food. She enjoyed the meal and ate well.*
>
> *The evening meal, when two CNAs had to feed or assist 12 or 13 residents with their meal, was a sharp contrast to the lunchtime experience, and Mrs. C. did not fare as well. For example, when the CNA approached Mrs. C. to offer her a cup of soup preceding the evening meal, the CNA called Mrs. C. by her first name and merely stated, "soup." As the CNA started to give the soup somewhat forcefully, Mrs. C. began to fling her arms and hands about and then placed her arms in front of her face and clamped her mouth shut. The CNA responded by holding down Mrs. C.'s arms and forcing her to drink the soup.*
>
> *When the dinner trays arrived, the residents were lined up against the wall and the CNAs walked back and forth from one to another, feeding three or four simultaneously. Each time the CNA returned to give Mrs. C. another large bite, a substantial amount of food still remained in her mouth. In a judgmental critical voice, the CNA shouted: "Oh my Lord, it's*

half in your mouth. Look at how much food she still has in her mouth! If she could only swallow faster. It's already pureed. If they will chew their food fast, it's easier for me. But see," she said, pointing to Mrs. C., "she still has food in her mouth." Not understanding that, because of dysphagia, Mrs. C. was unable to swallow quickly, she blamed her for eating slowly..

When staff have time to be patient and gentle, patients are less likely to resist assistance while performing activities of daily living. Though improvement in resisting ADLs is a new and previously untested quality measure, it examines a critical part of the home environment. Further studies will be needed to define the applicability and validity of this indicator.

We had anticipated that this measure would relate more closely to aide than licensed staffing, but we found, in Ohio, that RN staffing was the strongest predictor of resisting care improvement. There are two possible explanations for this. First, we are less confident about the accuracy of aide staffing ratios than licensed staffing ratios. Recall that the correlation between Medicaid cost report estimates and payroll data for aides was only .39, as contrasted with .73 for RNs. Second, adequate skilled nurse staffing will impact the behavior of nurse aides by allowing time for adequate supervision, training and a tone of patient, empathetic care. An RN who has adequate time to complete her work during her shift will be able to supervise aides more closely. She will have more time for training aides, both formally at in-services and informally during the course of a day's work. Her ability to provide patient and empathetic care will, by example, set a tone of patience and kindness for the aides she supervises.

This study has several limitations. The MDS, from which our long-stay quality measures were chosen, was not originally designed as a quality assessment tool. When completed by a trained research nurse, both functional and pressure ulcer measures derived from the MDS have been shown to be valid, but other, less objective measures have not. The MDS is completed by nurses at the facility; verifying its accuracy is not currently possible. We were able to examine MDS measures in only two states where the results were not completely consistent. The next phase of this project will need to address why these states, and perhaps others, differ in completion of MDS.

Medicaid cost report data only approximate the actual staffing levels in the facilities and may limit the generalizability of our study to non-Medicaid providers. While average staffing levels may differ in non-Medicaid facilities, associations between staffing levels and quality should not be fundamentally different. Medicaid cost report data approximated licensed staff ratios better than aide ratios, which may explain why our models were generally stronger for licensed than aide ratios.

In spite of these limitations, we have been able to show relationships between specific staffing levels and three important measures of quality in two populous states. These measures represent three different dimensions of quality for long-term nursing home residence. Pressure ulcers -- a painful and potentially dangerous problem -- are an important marker of skilled and unskilled nursing care requiring prevention

and treatment. Functional restoration is a major objective of nursing homes if residents are to reach their highest practicable level of function. Likewise, the quality of life for residents receiving daily personal care is of paramount importance in nursing homes.

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